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COMPUTER SECTION

Introduction to Hypertext and Hypermedia

*Lynda Hardman**

A brief History of Hypertext

The hypertext concept has been around for over 40 years. It was first described in Vannevar Bush's seminal article »As we may think« in 1945. Bush wrote about a personal filing system based on mechanical methods of storage for manipulating ideas.

»Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and to coin one at random, 'memex' will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.«

»It affords an immediate step, however, to associative indexing, the basic idea of which is a provision whereby any item may be caused at will to select immediately and automatically another. This is the essential feature of the memex. The process of tying two items together is the important thing.«

The article is still relevant today, although the technology Bush envisaged has been replaced by the digital computer.

In the early sixties Douglas Englebart implemented a system called Augment. This was designed to augment the intellectual capabilities of its users. The system has various features which can be classified under the hypertext label:

»Files are hierarchically structured, and textual address expressions can flexibly specify any text entity in any file. The screen may be divided into arbitrary, rectangular windows, allowing cross-file editing between windows. Many options exist for controlling the View' of a file's text in a window, e.g. level clipping, paragraph truncation, and content filtering.

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Structural study and modification of on-line documents are especially facilitated. A Journal system and 'Shared Screen Teleconferencing' support collaboration among authors and their colleagues.«

Ted Nelson coined the word hypertext round about this time. He was fascinated by the power the computer could give you for accessing information. He conceived the Xanadu system, which is designed to be the backend to data sharing on a world-wide basis. Nelson's vision is that:

»Everything should be available to everyone. Any user should be able to follow origins and links of material across boundaries of documents, servers and networks; and across boundaries of individual implementations«

»There should be a unified environment available to everyone, providing access to this whole space.«

Since the sixties a variety of systems have been created and used both commercially and in research environments. In particular Professor Peter Brown, at the University of Kent, developed a system called Guide for single-user workstations. The ideas in Brown's Guide were extended and implemented, for the Apple Macintosh and IBM personal computers, by Office Workstations Limited. The Guide product reached the market in 1986, a mere 41 years after Bush's article!

Figure 1 gives a flavour of reading a hypertext constructed in Guide on the Macintosh.

The Hypertext Concept

A very general definition of a hypertext system is one that allows the user to create links between items of information and to navigate through the body of information using these links. Links within the text can be made between words, phrases, paragraphs - whichever chunk of information is appropriate. Thus, some of the constraints of conventional linear text are removed by allowing conceptual links between items to physically exist by means of computer supported links. The links create a network of connections within the material and so allow readers to access parts of the information using multiple routes.

Hypertext also allows hiding of information: if you can access an extra piece of information by following a link (quickly) then that information does not have to appear in the current section. The reader is free to choose what to read and what to ignore, and is not obliged to scan through a long stretch of text of which only a small amount is relevant.

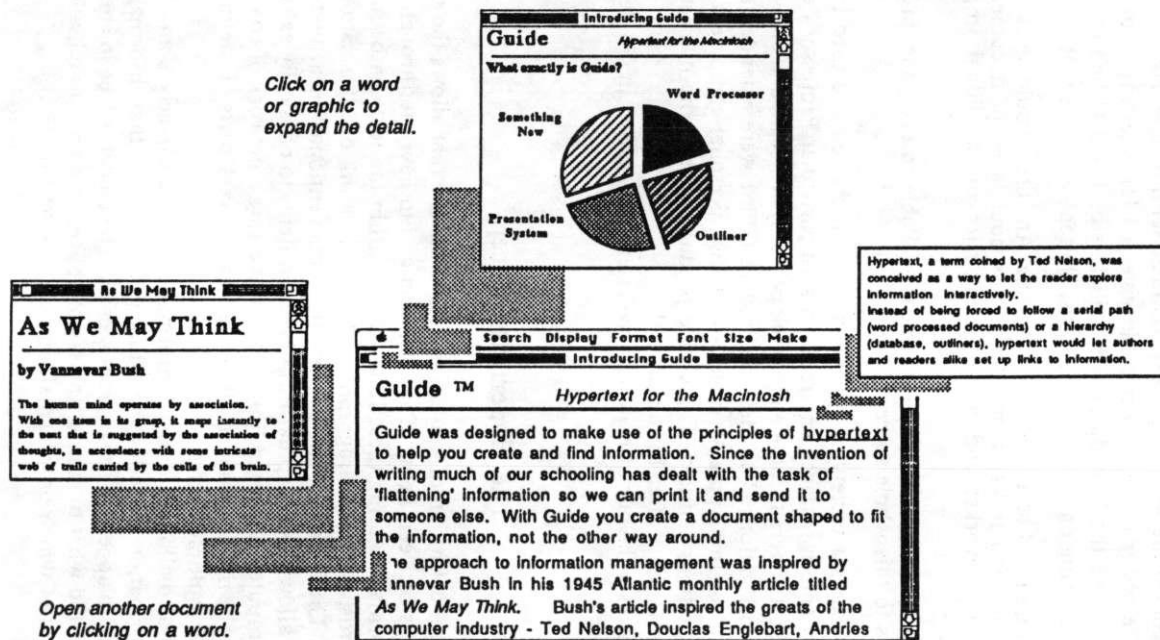


Figure 1 Reading a Guide hypertext on the Macintosh

. . . and Hypermedia

Hypermedia extends the hypertext concept of linking words or phrase together to include linking of other types of media. The most commonly used is graphics, where text can link to graphical items, and sometimes graphical items can link back to text. Other media which can be included are video, or other animation sequences, sound (music, speech), and other computer programmes. The same concepts apply - you want to link different items together. With text and graphics this is relatively straightforward - you can define sections of text or parts of graphic to start some video and/or sound sequence running. Ideally you would then like to be able to select items within the video which would then link to other parts of the information. Research is currently going on as to how you define these moving links.

Hypermedia systems can be used for different purposes. A completed hypertext can be treated much the same as a text book, where the information is fixed and available as a reference to the reader. Alternatively, many people can contribute to a growing hypertext, exchanging and commenting on each other's ideas. Both of these styles can be used in a teaching environment, where some material is presented to the student, which should not be altered, and students can create new material.

The appendix lists a (very small) number of hypermedia systems with notes on their different features for comparison.

Hypermedia in Education

The Intermedia hypertext system has been used for teaching English and Biology courses at Brown University (Rhode Island, USA). In both courses students are encouraged to draw upon the material in the hypertext in order to build up their own knowledge of the subject. In the English course they can see how writers, works and their literary periods are connected. In the Biology course different topics are interconnected in a way that is not possible in the sequential ordering in a text book. In both courses the developers of the material found they were beginning to think more explicitly about the connections in the information in their subject, and the students found they had a broader and deeper understanding of the course materials.

Guide is being used to teach pathology at Cornell University Medical College (USA). Both students and lecturers contributed to the construction of a large collection of material. Text and pictures of the basic course material are integrated with icons which lead to videodisk images, such as X-rays and microscope images. The system runs on a network of Mac ITs with 19" colour screens.

Here in the UK, at Coventry Polytechnic, students on the Faculty of Art and Design are being encouraged to use hypermedia systems to compose material. Their training in art and design has helped them in approaching these systems, which they use to model particular aspects of reality. They use the systems to combine visual material of various types as well as incorporating text where appropriate.

A hypermedia system can provide an environment for allowing instructors to create material which students can learn from by browsing through, according to their own ability or interest. The system provides tools for the instructor to combine text, graphics, video and sound clips in one integrated learning environment. As well as providing the material on the subject matter the instructor can add links to provide guidance for the student on paths through the material. Students can then create their own material, linking in to the material provided by the instructor.

Authoring Hypermedia

Once you have decided you would like to produce some material using a hypermedia system you need to choose which system to use. The first question is - what sort of information do you want to put into the system? Some hypermedia systems are more suited to certain operations than others, so even if the initial cost of the system is several hundred pounds more than another choice you could be saving months of effort trying to force particular structures on information in a system not designed to create them.

Another consideration is software for the students. Do you want them to have the full authoring facilities of the system you will be using? Will you then need multiple copies of the authoring system, or just (possibly cheaper) read-only versions? Do you want protection of your own carefully prepared material? Do you want students to be able to link in with your own material?

You then need to decide on which hardware you should use. Given a finite budget, you will want as many reasonably fast machines as possible for the students to use, and you (and any other main authors) will need a faster machine with more memory and hard disk space (you need to deal with more than the polished version released to the students). The performance of the hardware with the hypermedia system should be considered, as well as compatibility with other hardware systems that are around (colleagues may have beautifully authored drawings you could re-use).

Before you start creating the actual material make sure you have a very good design laid out for what you want to do. Unlike a linear environment, such as word processing, where when you change your mind you can move

things to »before« where you are, then change some wording so that »see earlier« becomes »see later«, you have to deal with changing complex reference or hierarchical structures. The more material there is already in place the harder structural changes become.

As an expert in your own field you should be able to produce well thought out material for the subject matter with meaningful links. This can then be put into the hypermedia system, but you also have to deal with the screen layout, making it meaningful as well as aesthetically pleasing. A crash course in aspects of human-computer interaction and graphics design would be desirable (but would no doubt eat into the hardware budget).

Two Hypermedia Tools

The most widely available tools for constructing hypermedia systems are Guide and HyperCard. Guide was designed specifically with on-line documentation in mind and has tools for creating hypertext structure and laying out text and graphics. It is available for IBM PCs and compatibles as well for Macintosh (and tools for converting files between the two machines environments will be available). HyperCard is less of a specifically hypertext system (more a »hypergraphics« system) but has its own programming language which can be used for purposes other than on-line information access (such as prototyping user interfaces to other pieces of software). Both systems can be used to run other programmes, such as an interactive video driver, although the mechanisms are very different.

Guide has been used to construct material for teaching. A physiology lecturer at University of Edinburgh Medical School has been constructing a tutorial on neuroanatomy for science and medical students. She has scanned in drawings and authored other pictures and combined them with relevant text in a package students can explore. An anatomy lecturer at the University of Leeds School of Medicine is currently involved with using Guide as a base for a broader learning environment which will include interactive video.

To give an idea of what these hypermedia systems might be used for in teaching Figure 2 shows a poem being read in Guide and Figure 3 shows part of a 4-stroke sequence of an engine. The engine example was authored in Guide, but a similar screen could have been produced using HyperCard.

Guide allows a number of windows on screen at once, and can scroll text and/or graphics in a window. The system does not have its own graphics authoring facilities, but if a picture has been put into the clipboard then it will go into Guide. A number of graphics items can be included in the same diagram and can then be linked, in the same way as text.

HyperCard displays one card at a time and uses bitmaps for its pictures, which for some types of drawing is not ideal (especially if you yourself are not an artist!). Text in HyperCard is kept in separate text items/ HyperCard's links are from an area on the screen to a different card, although links from text can be created by autoring separate routines using the HyperTalk language that comes with HyperCard.

There are now new products which are similar to HyperCard (card based with graphics authoring capabilities) which are worth looking at, such as SuperCard, but these are not given away with computer as HyperCard has been.

The philosophies behind the creation of Guide and HyperCard are very different, so with your own application in mind you should look at both systems and see which fits it more closely.

Where Next?

The BBC Domesday project has been around for a few years now and illustrated the concept of exploring information using the idea of pointing and selecting. It was one-off system, but with tools that are currently available educators can put together small, but highly specific, teaching packages. As CD-I technology develops more published material will become available.

I am currently working on a DELTA (Developing European Learning through Technological Advance) project where we are looking at how to put the information in a medical encyclopedia on a CD-I disk. This information will contain text, graphics, animation and sound in digital form on the disk. We then want to offer authoring facilities to instructors, for building specific teaching packages, and to students, so they can put their own interpretation on the material. There are problems that need to be solved at both the technological level - how do we get all our information on one disk - and the conceptual level - how do you reduce the perceived complexity of the system - before this particular system is viable.

In the meantime, there are tools around that will run on widely available machines which will allow you to use the technology and assess what hypermedia systems could do for you.

Love and Liberty

When lyart leaves bestrow the yird.
 Or, wavering like the bauckle-blrd.
 Bedim could Boreas' blast
 When hailstones drive wi' bitter skyte.
 And Infant frosts begin to bite.
 In hoary cranreuch drest;
 Ae night at e'en a merry core
 O' ran die, gangrel bodies
 In Poosie-Nansie's held the splore.
 To drink their orra duddies:
 Wl' quaffing and laughing
 They ranted an' they sang,
 Wl' jumping an' thumping
 The vera girdle rang.

When *withered* leaves bestrow the yird.
 Or, wavering like the bauckle-blrd.
 Bedim *cold* Boreas' blast;
 When hailstones drive wl' bitter skyte.
 And infant frosts begin to bite,
 In hoary cranreuch drest;
 Ae night at e'en a merry core
 O' ran die, gangrel bodies
 In Poosie-Nansie's held the splore.
 To drink their orra duddies:
 Wl' quaffing and laughing
 They ranted an' they sang,
 Wl' jumping an' thumping
 The vera girdle rang.

Figure 2 A poem with hypertext features.

The reader can find out the modern English meaning of the bold words (in Scottish dialect) by clicking on them. The poem on the left is as it first appears to the reader. The reader has clicked on lyart and could to give the version on the right, where the meanings of the words are in *italics*.

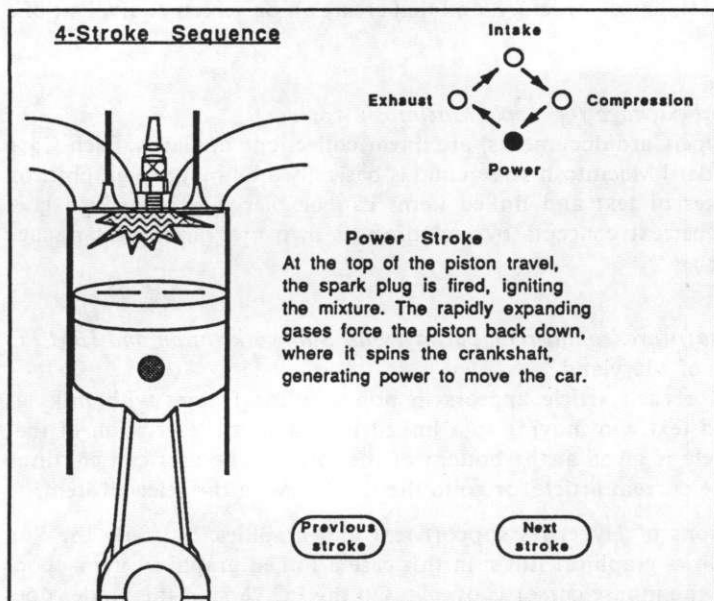


Figure 3 An explanation of the 4-stroke sequence

Reference

Bush, Vanneva, »As we may think«, reprinted in Computer Bulletin, March 1988 pp 35-40; originally published in Atlantic Monthly, July 1945

Appendix: A small selection of current hypermedia systems

Guide

Commercial package for IBM PC and Apple Macintosh
Office Workstations Limited

Guidelines (Guide documents) are text-based in scrollable windows, with graphics allowed anywhere within the text. Any piece of text or graphic can be made into a linked item, and the mouse cursor changes shape when it is over a linked item. As well as this »normal« hypertext link, which takes the reader from one place to another, Guide also has links that impose a hierarchical structure, and that create an on-screen equivalent of a footnote.

HyperCard

Commercial package for Apple Macintosh Apple

Stacks (HyperCard documents) are linear collections of Cards. Each Card fills a standard Macintosh screen and is basically a bit-mapped graphic, on which boxes of text and linked items can be placed. (HyperCard goes beyond hypertext concepts by including its own programming language HyperTalk.)

Hyperties

Research software/commercial packages for Sun workstation and IBM PC
University of Maryland

The text for each article appears in non-scrolling frames with links as highlighted text. On moving to a linked item a short description of that item's article is given at the bottom of the screen. The user can continue reading the current article, or go to the full entry on the selected item.

Both versions of Hyperties support text and graphics, but only the Sun version allows graphical links: in this case a linked graphical item »pops up« when the mouse cursor is over it. On the PC version the reader does not need a mouse, but instead uses arrow keys for moving around the items on the screen, then presses the return key to follow a link.

Intermedia

Research software for Sun workstation

Brown University

Intermedia's documents are text based in scrollable windows with graphics allowed within the text - similar to Guide. The links are separate from the text and graphics and are denoted by a marker in the window, and so some description of the link's destination has to be attached to the marker. This is done by placing a description of the link close to the marker, or, in the case where the link has several destinations, a menu of destinations is displayed. Intermedia is one of the few hypertext systems that allow links to have multiple destinations. Intermedia also has a facility for displaying a local network of links graphically.

KMS

Commercial package for Sun and Apollo workstations

Knowledge Systems Incorporated

KMS is the successor to the ZOG hypertext system and is frame based - as is HyperCard - where the frames can include text and graphics. Links are denoted by a marker and link that item to another frame. The 3 button mouse is used extensively, and cursor feedback is used to inform users what will happen when they press a mouse button. The designers have tried to keep response times to less than one second, to allow users to reorient themselves (if they need to) by going back and forth in the document space.

NoteCards

Research software for Xerox workstations, also available commercially

Xerox Parc

A NoteCards hypertext is constructed by linking Notes together. A Note contains text in a scrollable window. There are other facilities for having nontextual items, for example graphics, in other windows. Links start at an item within a note and go to another Note. A map of the network of links in a particular set of Notes can be generated. There are special File Cards which impose a hierarchical organisation on a set of Notes.